Breathing Better: The Case for Air Filtration in K–12 Schools

A Policy Whitepaper for School Administrators, District Decision-Makers, School Board Members, and Facilities Directors

Produced by Filterbuy Business, a provider of school air quality solutions. This document is intended as an objective, evidence-based educational resource.

Executive Summary

America's schools are facing a silent crisis. While much attention is paid to curriculum, staffing, and technology, the air inside school buildings — the very medium through which students and teachers think, breathe, and learn — is often so poor as to measurably harm health and academic performance.

The evidence is no longer ambiguous. Decades of research, reinforced dramatically by the COVID-19 pandemic, confirm that indoor air quality (IAQ) directly affects student absenteeism, asthma rates, respiratory illness, cognitive function, and standardized test performance. Yet the U.S. Government Accountability Office (GAO) has found that roughly half of all public schools need HVAC upgrades or replacements, and millions of students spend their days in buildings that fail to meet basic ventilation standards.

The good news: solutions are available, proven, and — particularly given current federal and state funding opportunities — more financially accessible than ever.

Key findings:

- More than 41 million students attend schools with substandard air quality infrastructure.
- Improving ventilation and filtration can reduce student absenteeism by 10–15% and significantly lower rates of asthma-related illness.
- Students in well-ventilated classrooms demonstrate measurably higher cognitive performance — in some studies, up to 61% better on key reasoning tasks.
- A range of filtration technologies — from upgraded MERV filters to portable HEPA units — offer scalable, cost-effective paths forward for districts of all sizes.
- Federal, state, and grant funding can offset or eliminate upfront costs for qualifying districts.

This whitepaper urges school leaders to treat air quality as a foundational educational investment — as essential as textbooks, broadband, or safe drinking water.

Section 1: The Problem — A Crisis Hidden in Plain Sight

The State of School Buildings

American school buildings are aging. According to a 2020 GAO report, 54% of public-school districts need to update or replace multiple building systems, with HVAC systems topping the list. The average U.S. school building is over 40 years old — constructed long before modern IAQ standards were developed. Many rely on systems that are functionally obsolete, chronically under-maintained, or simply inadequate for current occupancy levels.

The EPA estimates that approximately 11 million students attend schools with documented indoor air quality problems in every region of the U.S.

What's in the Air

School air frequently contains a complex and harmful mixture of pollutants:

Particulate Matter (PM2.5 and PM10): Fine particles from outdoor traffic, chalk dust, cleaning products, and printer toner penetrate deep into the lungs. PM2.5 exposure is linked to asthma exacerbation and impaired lung development in children.

Volatile Organic Compounds (VOCs): Emitted by paints, adhesives, flooring, cleaning agents, and art supplies, VOCs include benzene and formaldehyde. Short-term exposure causes headaches and eye irritation; long-term exposure carries carcinogenic risk.

Carbon Dioxide (CO_2): As students and teachers exhale, CO_2 builds up in poorly ventilated classrooms. At levels above 1,000 ppm — easily reached in crowded rooms — cognitive performance measurably declines. Filtration alone cannot address CO_2; adequate fresh-air ventilation is required.

Mold and Biological Contaminants: Water intrusion and humidity mismanagement create conditions for mold growth. The EPA estimates that one in five U.S. schools has conditions favorable to mold — a potent allergen and asthma trigger.

Allergens and Infectious Aerosols: Dust mites, pollen, and pest allergens are pervasive triggers for allergic rhinitis and asthma. COVID-19 reframed public understanding of airborne disease transmission, making clear that respiratory viruses spread via aerosols that linger in poorly ventilated spaces.

COVID-19 as a Catalyst

The pandemic exposed just how far most school facilities fell short of basic ventilation standards. The CDC and ASHRAE issued guidance recommending enhanced ventilation, MERV-13 filtration, and portable air cleaners as mitigation tools. Emergency investments that many districts made in 2020–2022 demonstrated not just pandemic resilience but also year-round IAQ benefits. The infrastructure that protects against COVID also protects against flu, asthma, and chronic cognitive impairment.

Section 2: Why It Matters — Health, Learning, and Well-being

Student Health

Asthma is the leading chronic disease among school-age children, affecting approximately 5.5 million students in the U.S. (CDC, 2022) and accounting for an estimated 13.8 million missed school days annually. Research published in *Environmental Health Perspectives* found that children in schools with higher indoor pollutant levels had significantly higher rates of asthma symptoms, wheeze, and respiratory infections. The Institute of Medicine has concluded that sufficient evidence links indoor dampness and mold to upper respiratory tract symptoms and asthma exacerbation in children.

Cognitive Performance and Academic Outcomes

Perhaps the most compelling — and underappreciated — dimension of the IAQ case is its direct impact on learning.

The landmark 2015–2016 COGfx studies by researchers at the Harvard T.H. Chan School of Public Health found that participants in well-ventilated environments with low CO_2 and VOC levels scored 61% higher on cognitive performance tests than those in conventional indoor settings. While conducted in office environments, the physiological mechanisms are identical in children, and the implications for classrooms are direct.

Danish research found that improving classroom ventilation led to a 14.5% improvement on standardized cognitive tests. A study published in *Building and Environment* found that reducing classroom CO_2 from over 2,000 ppm to below 900 ppm was associated with significant gains in reading comprehension and math performance. Research examining Texas schools found that students in classrooms meeting ASHRAE ventilation standards performed significantly better on state assessments than peers in inadequately ventilated rooms — after controlling for socioeconomic variables.

Teacher and Staff Wellbeing

Teachers and staff spend even more time in school buildings than students. A 2018 study in the *International Journal of Environmental Research and Public Health* found that teachers in poorly ventilated schools reported significantly more sick days than colleagues in buildings meeting IAQ standards. Improving the physical work environment is a tangible, evidence-supported contribution to teacher recruitment and retention.

The Equity Dimension: Poor IAQ disproportionately affects schools serving low-income communities and students of color. Older buildings are more prevalent in under-resourced districts, and students with asthma — whose condition is most acutely worsened by poor air quality — are disproportionately from low-income, Black, and Hispanic communities. Investing in air quality is, among other things, an equity investment.

Section 3: The Solution — Air Filtration Technologies for Schools

No single technology solves every IAQ challenge. The right approach depends on existing infrastructure, budget, building age, and specific pollutant profiles.

MERV-Rated Filter Upgrades

Most existing school HVAC systems use filters in the MERV 4–8 range — adequate for large debris but ineffective against fine particles, allergens, and aerosols. Upgrading to MERV 11–13 significantly improves the capture of PM2.5, allergens, and respiratory aerosols, and is recommended by both ASHRAE and the CDC.

An important caution: higher MERV ratings can increase airflow resistance. Installing a MERV 13 filter in a system designed for MERV 6 can reduce airflow, strain equipment, and paradoxically worsen air quality. Districts should have a qualified HVAC professional evaluate system capacity before upgrading filter ratings. A tiered approach — MERV 10–11 for general classrooms, MERV 13 for health-sensitive spaces like nurse's offices — often makes more practical sense than a uniform building-wide upgrade.

Pros: Lowest-cost intervention; works within existing systems; minimal disruption. **Cons:** Cannot address CO2; requires system compatibility evaluation. **Estimated cost:** $3-$15 per filter to move from MERV 8 to MERV 11; $3–$20 per filter to move from MERV 11 to MERV 13: $12-80 annually per unit.

Portable HEPA Air Purifiers

Standalone HEPA-equipped air purifiers placed in classrooms offer an immediately deployable solution requiring no HVAC modification. When properly sized for the room (by Clean Air Delivery Rate, or CADR), they can achieve 4–6 air changes per hour — meeting or exceeding ASHRAE recommendations.

Pros: Fast to deploy; no construction required; flexible; cost-effective per unit. **Cons:** Requires per-room maintenance; filter replacement costs; some noise. **Estimated cost:** $150–$700 per unit; $30–$80 annually in filter replacements.

UV-C Germicidal Systems

UV-C light systems installed in HVAC ducts or as in-room upper-air units use ultraviolet radiation to inactivate bacteria, viruses, and mold spores. They complement particle filtration by targeting biological contaminants.

Pros: Highly effective against pathogens; no filter media replacement. **Cons:** Does not capture particles; higher upfront cost; requires trained maintenance. **Estimated cost:** $500–$10,000 depending on system type and size.

HVAC Upgrades with Energy Recovery Ventilators (ERVs)

The most comprehensive intervention is upgrading aging HVAC systems to meet the ventilation rates of ASHRAE Standard 62.1. Adding energy recovery ventilators allows more fresh air intake without excessive energy cost — the only approach that directly addresses CO2 buildup.

Pros: Addresses root causes; reduces CO2; modern systems offer energy savings. **Cons:** Highest upfront cost; requires capital planning. **Estimated cost:** $10–$40 per square foot; a full replacement for a 50,000 sq ft building may cost $500,000–$2,000,000. Targeted ERV additions are substantially less.

Technology	Best For	Cost	Addresses CO2?
MERV 11–13 Filter Upgrade	Particle/aerosol reduction	Low	No
Portable HEPA Purifier	Rapid classroom-level deployment	Low–Med	No
UV-C Germicidal Systems	Pathogen inactivation	Medium	No
HVAC Upgrade + ERV	Comprehensive, long-term solution	High	Yes

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Section 4: Real-World Evidence

Regulatory and Research Foundation

The CDC, EPA, and ASHRAE have all issued direct guidance supporting air filtration in schools. The EPA's "IAQ Tools for Schools" program (https://www.epa.gov/iaq-schools/iaq-tools-schools-resources) provides frameworks and resources for districts to assess and address IAQ. ASHRAE Standard 62.1 establishes minimum ventilation rates of 10–15 cubic feet per minute per person for school spaces — rates that most older school buildings do not meet.

Keefe Technical School, Framingham, Massachusetts — MERV Filter Upgrade

Keefe Technical School, a 300,000-square-foot vocational facility, undertook a targeted HVAC filter upgrade following professional ductwork cleaning. The school replaced aging MERV 6 cartridge-type filters with 4-inch MERV 11 pleated filters. Per the National Air Filtration Association (NAFA), the upgrade produced three measurable benefits: improved overall IAQ for students and staff, cleaner ductwork that reduced maintenance requirements, and more efficient operation of heating and cooling coils. Facilities staff reported that the higher-efficiency filters, despite their greater initial cost, reduced total labor and disposal costs due to their longer service life — illustrating that filter quality and total cost of ownership are not the same number.

Thames Valley District School Board, Ontario — Systematic Filter Program

Beginning in 2000, the Thames Valley District School Board — overseeing 195 school locations — replaced low-MERV filters with a standardized MERV 8 pleated filter program after sustained complaints from parents, teachers, and custodial staff about air quality. Working with filtration specialists, the board developed a district-wide changeout schedule and assembled a "filter committee" to oversee ongoing compliance. According to NAFA, which awarded Thames Valley its Clean Air Award in 2004, the district reported significant cost savings in housekeeping and equipment maintenance as a direct result of cleaner air and cleaner HVAC systems — a real-world demonstration that proactive filter management pays dividends beyond health outcomes.

Denver Public Schools, Colorado

Denver Public Schools invested $4.9 million in HVAC upgrades during summer 2020 and committed an additional $25 million of ARP funding toward ventilation improvements through 2024. Post-upgrade monitoring data showed that CO_2 levels dropped an average of 30% in upgraded classrooms, and PM2.5 decreased by more than 40% in rooms equipped with HEPA purifiers. Teachers reported fewer sick days in the year following the intervention.

Greene County School District, Tennessee

This smaller rural district invested $8.9 million in bonds to replace HVAC systems across the district — nearly half of which had exceeded their 20-year life expectancy. Beyond the IAQ improvements, the upgrades are projected to save the district more than $5 million in energy costs over the life of the systems, demonstrating that infrastructure investment can simultaneously improve student health and reduce operating costs.

Section 5: The Financial Case — Costs, Savings, and Funding

The Cost of Doing Nothing

Student absenteeism has a direct financial cost: most state funding formulas are tied to average daily attendance (ADA). A district with 10,000 students losing five illness-related days per student annually loses the funding value of 50,000 student-days — at $40–$60 per student per day, that represents $2–$3 million in foregone revenue each year.

The EPA has calculated that every dollar invested in school IAQ improvements generates approximately $3–$13 in return through reduced absenteeism, lower healthcare costs, and productivity gains. A 2017 analysis in the *Journal of Exposure Science & Environmental Epidemiology* estimated that improving ventilation in U.S. schools to ASHRAE standards would yield a net economic benefit of approximately $37 billion annually.

Addressing the Cost Objection

Not all interventions are expensive. Upgrading HVAC filters to MERV 11–13 costs hundreds of dollars per unit, not thousands. Portable HEPA purifiers run $150–$700 each. A district can meaningfully improve IAQ in its highest-need classrooms for a fraction of a comprehensive

HVAC overhaul. Phased implementation allows costs to be spread across multiple budget cycles, prioritizing the most impacted buildings first.

Available Funding Sources

ESSER Funds: Congress appropriated approximately $190 billion across ESSER I, II, and III. Allowable uses explicitly include HVAC upgrades, MERV 13 filters, and portable air cleaners. Districts with remaining obligated funds should confirm current spending deadlines with their state education agency.

EPA Programs: The EPA's Clean Air in Buildings Challenge, Clean Air Act grants, and Inflation Reduction Act school climate provisions offer targeted support for school IAQ improvements.

USDA Community Facilities Program: Rural districts may access USDA grants and loans for building infrastructure, including HVAC upgrades.

State Programs: California, New York, New Jersey, Colorado, Illinois, and others have dedicated funding streams for school ventilation improvements. Districts should consult their state education department and state EPA for current availability.

Energy Efficiency Incentives: HVAC upgrades that improve energy efficiency may qualify for utility rebates. Modern ERVs often recover a portion of their cost in energy savings within 5–7 years.

Local Bonds and Levies: Post-COVID, community awareness of school air quality has risen substantially. Many districts have successfully brought IAQ and facilities improvement bonds before voters with strong community support.

Section 6: Implementation Roadmap

Step 1: Conduct a Building-Wide IAQ Assessment (Months 1–3)

Begin with data. Use your facilities team or engage a certified industrial hygienist to assess: current HVAC filter ratings and system condition; CO2 levels across classrooms (low-cost CO2 monitors run $100–$300 each); evidence of moisture intrusion or mold; and ventilation rates relative to ASHRAE 62.1. The EPA's "IAQ Tools for Schools" program provides free assessment frameworks.

Step 2: Prioritize by Need (Months 3–4)

Focus initial resources on buildings with the oldest HVAC systems, classrooms with the highest CO2 readings, and schools serving populations with elevated asthma rates or chronic absenteeism. This triage approach maximizes health impact per dollar spent.

Step 3: Select and Procure Technologies (Months 4–6)

A practical tiered approach for most districts: immediately upgrade all HVAC filters to the highest MERV rating the system can support (evaluated by a qualified contractor); deploy portable HEPA units in high-priority classrooms; install CO2 monitoring in all classrooms; and develop a multi-year capital plan for HVAC replacement in buildings below ASHRAE standards. Use cooperative purchasing agreements (OMNIA Partners, E&I Cooperative, or your state co-op) to reduce costs and administrative burden.

Step 4: Communicate and Engage Stakeholders

Communicate transparently with parents, teachers, and board members about assessment findings, the investment plan, and expected outcomes. Parent and teacher organizations are often powerful advocates when given the evidence, and community support is practically valuable when seeking board approval or bond funding.

Step 5: Monitor and Maintain (Ongoing)

IAQ is not a one-time fix. Establish a regular filter replacement schedule (quarterly for high-occupancy spaces); review CO2 and IAQ monitoring data regularly; conduct annual building walkthroughs for mold and moisture; and track absenteeism, nurse visits, and academic performance year over year. The EPA's "IAQ Tools for Schools Framework for Effective School IAQ Management" provides a complete management system template at no cost.

Section 7: Conclusion and Policy Recommendations

The evidence assembled here leads to one conclusion: the quality of air in K–12 school buildings is a determinant of student health, cognitive performance, and academic achievement — and it is within the power of school leaders to improve it.

This is not a fringe position. It is the consensus view of the CDC, EPA, ASHRAE, and a robust body of peer-reviewed research. The economic case — in reduced absenteeism, lower healthcare costs, and the compounding value of better learning — is equally strong.

Policy recommendations for district leaders:

1. **Adopt IAQ as a district educational priority.** Assign formal responsibility to a designated staff member or committee.
2. **Conduct a comprehensive IAQ audit within 12 months.** Establish a baseline using EPA frameworks and, where budgets allow, certified professionals.
3. **Upgrade HVAC filtration to MERV 11–13 minimum** — with system compatibility verified by a qualified contractor before implementation.
4. **Deploy portable HEPA air purifiers in highest-priority classrooms** — targeting rooms with the oldest systems and highest respiratory illness rates.

5. **Develop a capital plan for HVAC upgrades.** Build a multi-year roadmap leveraging federal, state, and local funding.
6. **Install CO_2 monitoring in every classroom.** Real-time data empowers both immediate action and long-term investment decisions.
7. **Integrate IAQ metrics into annual district reporting** to build community trust and sustain support for ongoing investment.

Every day without action is a day in which students breathe air that makes them sicker, more absent, and less capable of learning. The tools, the evidence, and the funding exist. What is needed is the leadership to act.

The investment in cleaner air is not a cost. It is a foundation.

References and Key Resources

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This whitepaper is produced by Filterbuy Business, a provider of school air quality solutions. It is intended as an objective, educational resource to support evidence-based decision-making by K–12 school district leaders. Figures and statistics are drawn from publicly available research and government reports. Districts are encouraged to consult directly with certified IAQ professionals and their state education agencies for jurisdiction-specific guidance.

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